

TRAJECTORY-CAPTURE CELL INSTRUMENTATION FOR MEASUREMENT OF DUST PARTICLE MASS, VELOCITY AND TRAJECTORY, AND PARTICLE CAPTURE* :J.A. Simpson and A.J. Tuzzolino, Laboratory for Astrophysics and Space Research, Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637

Our earlier development of the PVDF dust detector (1) for space missions--such as the Halley Comet Missions where the impact velocity was very high (2) as well as for missions where the impact velocity is low (3)--have been extended to include:

- a) the capability for impact position determination - i.e., x,y coordinate of impact, as illustrated in FIG. 1a (3) and;
- b) the capability for particle velocity determination using two thin PVDF sensors spaced a given distance apart - i.e., by time-of-flight (4,5).

Our recent dust accelerator calibrations have shown that for two thin [6 μ m thick] PVDF sensors in such an arrangement, particle fragmentation effects are not severe for particles having diameter $> \sim 10\mu$ m and velocities in the range ~ 2 -12 km/s. Thus, following particle penetration of two thin PVDF sensors, sufficient mass [in the form of one or a few fragments] is available for capture by a suitable capture cell device for analysis (4,5). These developments have led to space flight instrumentation for recovery-type missions illustrated in FIG. 1b and c, which will measure the masses [sizes], fluxes and trajectories of incoming dust particles and will capture the dust material in a form suitable for later Earth-based laboratory measurements. These laboratory measurements would determine the elemental, isotopic and mineralogical properties of the captured dust and relate these to possible sources of the dust material [i.e., comets, asteroids], using the trajectory information. For each incident particle, the instrumentation will:

- a) measure signal sizes from the upper and lower plane sensors penetrated;
- b) determine which sensors are penetrated;
- c) measure time-of-flight for the penetrated sensors, and;
- d) determine the capture cell containing particle residue.

If each sensor is an x,y sensor, particle trajectory is determined with an angular accuracy of $\sim 1^\circ$. If each sensor is non-position sensing, trajectories are measured with a mean accuracy of $\sim 5^\circ$. The instrumentation described here has the unique advantages of providing both orbital characteristics and physical and chemical properties--as well as possible origin--of incoming dust.

- (1) Simpson, J.A. and Tuzzolino, A.J. (1985) Nucl. Instr. & Meth., **A236**, p. 187.
- (2) Perkins, M.A., Simpson, J.A. and Tuzzolino, A.J. (1985) Nucl. Instr. & Meth., **A239**, p. 310.
- (3) Simpson, J.A. (An invited paper presented at the Workshop on the Multi-comet Missions, NASA/Goddard Space Flight Center, Sept. 17, 1986), EFI Preprint No. 86-81.
- (4) Simpson, J.A. and Tuzzolino, A.J., to be submitted for publication, EFI Preprint No. 87-106.
- (5) Simpson, J.A. and Tuzzolino, A.J., to be submitted for publication, EFI Preprint No. 88-69.

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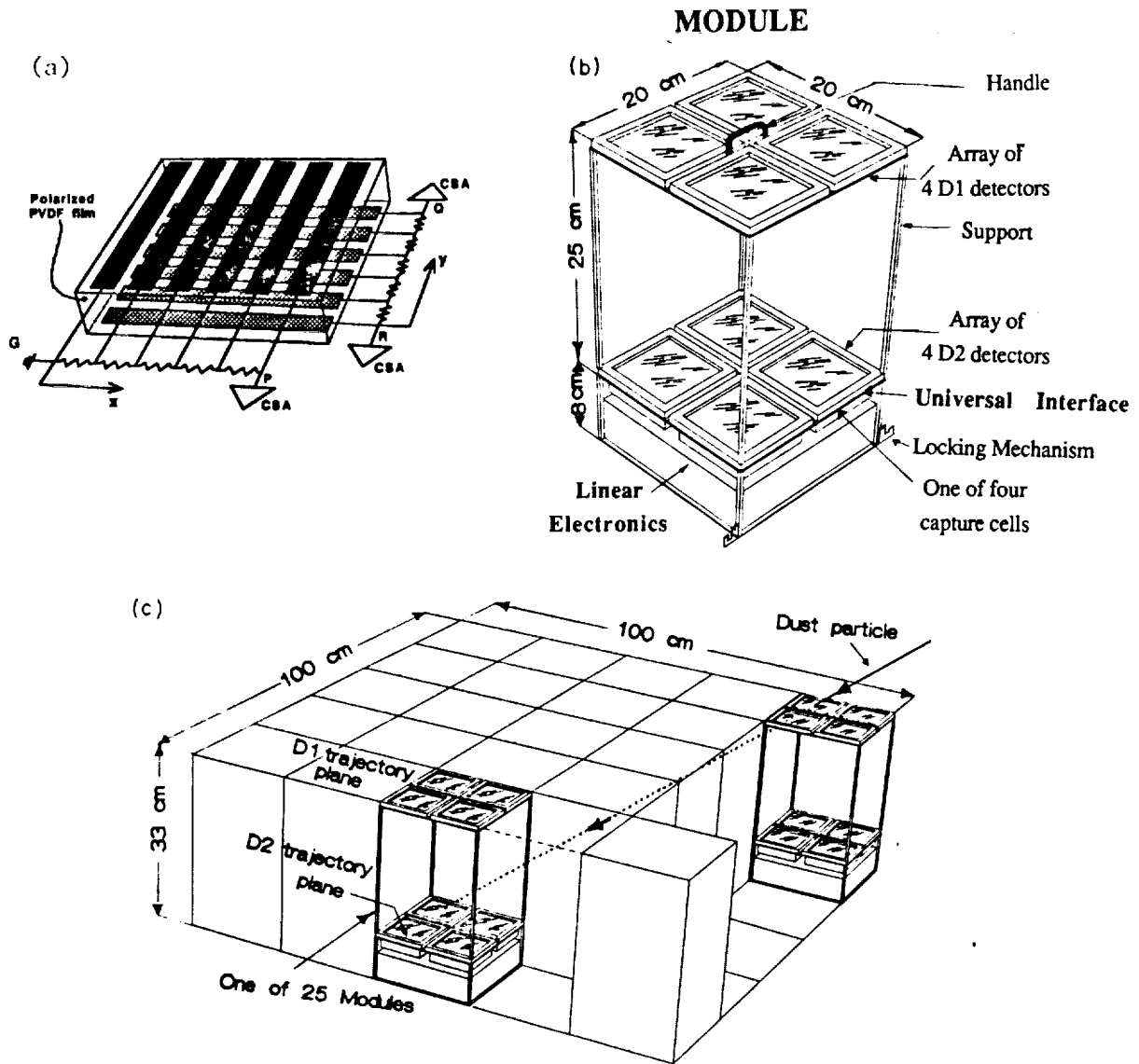


Fig. 1 (a) Two-dimensional position sensing PVDF detector (x,y detector). Upon dust particle impact, P, Q, R signals are generated. The x coordinate of impact is determined from the ratio $P/[Q+R]$ and the y coordinate from the ratio $Q/[Q+R]$. (b) Trajectory-capture cell MODULE. The four D1 and four D2 PVDF detectors are either x,y detectors, or may be non-position-sensing. The capture cells have a depth ~ 1 cm. (c) Basic instrument consisting of 25 identical MODULES. Trajectories are determined for angles of incidence up to $\sim 78^\circ$. The geometry factor for trajectory measurement is $0.37 \text{ m}^2 \text{ ster}$.